
Name of Organization: USGS/USFWS

Type of Organization: Federal Agency

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Project Title: Endocrine-Disrupting Effects of Mercury in Lake Trout

Project Category: Emerging Issues

Rank by Organization (if applicable): 0

Total Funding Requested (\$): 218,360 **Project Duration:** 2 Years

Abstract:

An environmental problem in the Great Lakes ecosystem is the potential ecological and human health impacts of chemicals that disrupt the endocrine system. Though significant progress has been made by Federal, State and Provincial agencies in rehabilitating fish communities in the Great Lakes the past 25 years, lack of sustained natural reproduction of lake trout and chinook and coho salmon highlight the need to reevaluate this effort. Several factors, including bioaccumulation of contaminants in these fishes have been suspected to be responsible for their lack of natural reproduction. Mercury is a contaminant of concern being studied under the Lake Ontario Modeling Improvement Plan (LOMIP) and Lake Michigan Mass Balance (LMMB) program. The work proposed will augment the Lake Michigan and Ontario programs by evaluating the biological effect of mercury on reproduction in native lake trout. We will determine the effect of mercury on key reproductive hormones and reproduction in lake trout. The resulting empirical formula will be used to estimate reproductive failure due to mercury in feral fish.

Geographic Areas Affected by the Project

States:

<input checked="" type="checkbox"/> Illinois	<input checked="" type="checkbox"/> New York
<input checked="" type="checkbox"/> Indiana	<input checked="" type="checkbox"/> Pennsylvania
<input checked="" type="checkbox"/> Michigan	<input checked="" type="checkbox"/> Wisconsin
<input type="checkbox"/> Minnesota	<input checked="" type="checkbox"/> Ohio

Lakes:

<input type="checkbox"/> Superior	<input type="checkbox"/> Erie
<input type="checkbox"/> Huron	<input type="checkbox"/> Ontario
<input type="checkbox"/> Michigan	<input checked="" type="checkbox"/> All Lakes

Geographic Initiatives:

<input type="checkbox"/> Greater Chicago	<input type="checkbox"/> NE Ohio	<input type="checkbox"/> NW Indiana	<input type="checkbox"/> SE Michigan	<input type="checkbox"/> Lake St. Clair
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Primary Affected Area of Concern: All AOCs

Other Affected Areas of Concern:

For Habitat Projects Only:

Primary Affected Biodiversity Investment Area: Not Applicable

Other Affected Biodiversity Investment Areas:

Problem Statement:

One of the major environmental problems in the Great Lakes ecosystem is the potential ecological and human health impacts of chemicals that disrupt the endocrine system, a network of glands and organs regulating many biological functions, including growth, metabolism, reproduction, and the immune system through chemical messengers known as hormones. Chemicals that elicit endocrine-disrupting effects in animals include a wide range of organic compounds and pesticides. Though significant progress has been made by Federal, State and Provincial agencies in rehabilitating fish communities in the Great Lakes the past 25 years, lack of sustained natural reproduction of lake trout and chinook and coho salmon highlight the need to reevaluate this effort. Several factors, including bioaccumulation of contaminants in these fishes have been suspected to be responsible for their lack of natural reproduction. Mercury is one of the contaminants of concern being studied under the Lake Ontario Modeling Improvement Plan (LOMIP) and Lake Michigan Mass Balance (LMMB) program. Mercury is also a potential endocrine disruptor in fish and is responsible for lakewide impairments in the Great Lakes. The LOMIP and LMMB are helping us understand where contaminants are entering Lakes Ontario and Michigan, respectively, and what happens to them as they move through the aquatic environment. However, LOMIP and LMMB do not incorporate data on the physiological response of fish exposed to these contaminants into their models, and therefore cannot predict how fish populations will ultimately sustain themselves in the Great Lakes. The proposed study will focus on the endocrine-disrupting effects of mercury, and the results will be used to develop a model to help fishery managers predict reproductive potential of lake trout in the Great Lakes based on the fish's mercury burden. The results of the proposed study can also be used to refine the beneficial use impairment assessments in the Lake Ontario and Lake Erie Lake wide management plans (LaMP). Furthermore, data from the proposed study can be incorporated into the models being developed by LOMIP and LMMB to predict the physiological response of lake trout to contaminants, and ultimately, their population in the Great Lakes.

Dr Fynn-Aikins and associates recently completed a similar study with largemouth bass in the Everglades. The findings of this study, which were presented at SETAC, 1998, strongly suggest that mercury is an endocrine disruptor in fish. Members of the Lower Great Lakes Lake Trout Coordinating Committee, including the Fish and Wildlife Service, New York State Department of Environmental Conservation, U.S. Geological Survey, and the Pennsylvania Fish and Boat Commission have been stocking lake trout into Lake Erie and Ontario for decades, but there is lack of natural reproduction by the trout. Though endocrine disrupting chemicals have been suspected of being the cause of the lack of natural reproduction, none of these management agencies have investigated the impact of critical pollutants on reproductive potential of lake trout or other Great Lakes fishes. We propose to investigate the endocrine disrupting effects of mercury, known to bioaccumulate in top predatory fish like lake trout and is one of the critical pollutants of concern to the Lakes Erie and Ontario LaMPs.

Proposed Work Outcome:

The objectives of this study are to: 1) Investigate effect of methyl mercury on reproductive hormones (testosterone and estrogen) and reproductive effort under controlled environmental conditions; 2) Use logistic regression, with data collected, to develop an empirical model to predict reproductive success of feral lake trout exposed to mercury contamination in the Great Lakes; and 3) Determine habitats in the Great Lakes where lake trout recruitment will be at risk of mercury contamination.

Lake trout will be collected from different aquatic habitats in the Great Lakes. Muscle tissue and fish blood will be collected from these fish and stored for later mercury and hormone analyses. The laboratory phase will be used to induce mercury burdens in lake trout broodfish similar to those found in the Great Lakes. This will be accomplished by feeding a commercial diet spiked with different levels of methyl mercury to fish in replicate groups per dietary treatment for at least 6 months. Periodically, 3 fish from each tank will be killed, and muscle tissue and fish blood will be collected and stored in an for analysis. Muscle tissue and blood will be analyzed for mercury and reproductive hormones (testosterone and estrogen), respectively. At the end of the feeding trial, lake trout will be spawned and the reproduction success of fish in each treatment group will be determined. An activated charcoal filtration system will be installed in fish tank effluents to trap dissolved mercury and any mercury in feces and uneaten feed to minimize contamination of receiving waters. Based on data generated from the feeding trial, a logistic regression analyses will be used to develop an empirical model to predict reproductive success of lake trout exposed to mercury contamination in Great Lakes habitats.

Project Milestones:**Dates:**

Project Start, Laboratory feeding	04/2001
Complete feral fish collection	10/2002
Complete laboratory fish study	02/2002
Complete Mercury and hormone analysis	03/2003
Final Report	04/2003
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☐ Project Addresses Environmental Justice

If So, Description of How:

☒ Project Addresses Education/Outreach

If So, Description of How:

Highly visible results. The results of this work would be presented at workshops of regional scientists and managers, national meetings of scientific societies, and international conferences. The reports and publications resulting from the work will also be widely distributed. Reports will be served on the Internet and the publications will be in highly respected, peer-reviewed scientific journals.

Project Budget:

	Federal Share Requested (\$)	Applicant's Share (\$)
Personnel:	60,000	60,000
Fringe:	15,000	15,000
Travel:	8,000	0
Equipment:	0	100,000
Supplies:	20,000	0
Contracts:	60,000	0
Construction:	0	0
Other:	0	0
Total Direct Costs:	163,000	175,000
Indirect Costs:	55,360	0
Total:	218,360	175,000
Projected Income:	0	0

Funding by Other Organizations (Names, Amounts, Description of Commitments):

Currently this project is not funded from any source.

Description of Collaboration/Community Based Support:

There is broad support for this work. Great Lakes Lake Trout Coordinating Committee, including the Fish and Wildlife Service, New York State Department of Environmental Conservation, U.S. Geological Survey, Pennsylvania Fish and Boat Commission, Michigan DNR, Wisconsin DNR, Indiana DNR, Illinois DNR, Native Indian tribes, Canadian Department of Fisheries and Oceans, and Canadian provinces strongly support restoration of lake trout.